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DO PUBLIC POLICIES THAT FOSTER CO-OPERATION IN INNOVATION AUGMENT THE CO-OPERATIVE ATTITUDE: THE EMPIRICAL FACTS

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ABSTRACT

In this paper I offer a revision of the empirical literature on Evaluation of policies fostering co-operation in innovation. Afterwards we analyse the case of the Spanish support on this topic. First I present a critical review of the methods and findings of the existing empirical literature was made in an attempt to answer the question whether the policy of promotion of co-operation has been effective or not. Afterwards I analyse the impact of the public support for co-operative R&D in Spain

In general, evaluation studies, systematically revised for this article, have analysed the impact on co-operation, in a broad sense but, as can be seen, very diverse indicators have been used, so the findings are difficult to compare. The findings-reflected in the examination of the evaluation studies (based on surveys) - assess, on the one hand, the impact of public aid fostering co-operation among the agents of the innovation system as very positive. But, on the other hand, these highly optimistic findings are not altogether free from suspicion. Because the non-survey-based indirect indicators, do not point to such a successful and indisputable impact. The final conclusion could be that the policies focused on co-operation mostly do deepen or intensify the existing collaborations of the firms already involved in co-operations. While the amplification of the co-operative attitude by non-co-operative firms is less successful.

1. INTRODUCTION

Some general trends have led to the increasing importance of co-operation in the field of innovation: a large number of the new scientific challenges are increasingly more capital-intensive, the life cycles of products and technologies are increasingly shorter, and the complexity and interdisciplinary nature of technologies-needed for the development of a new product- has increased in parallel with the need to have capacity in different technological areas. These trends complicate the individual actions of firms and have made innovation such a complex, risky and costly activity – in terms of finance and time-that even large firms cannot always finance it by themselves, nor can they cover all the necessary technological areas. Indeed, growing costs in science demand ever higher investment, sometimes difficult for individual agents to bear and, hence, there exists the need to optimize resources (Kulicke et al., 1997).

A more important question is why the government should support co-operation. The aforementioned theories suggest that the firms will co-operate also without public support. However, the modern theories of technological change (the evolutionary theory) argue that co-operation do generate externalities for the society or economy as a whole conceptualised by the notion of *collective learning*. The learning aspects includes; technology transfer due to the improvement of the technological capabilities of the participants of co-operative projects; interchange or flows of information (feedbacks) between industry and science that can help to reorient scientific programmes to the needs and problems in industry; acceleration of the innovative solution for societal problems (SARS, AIDS) or the development of key technologies to assure sustainable international competitive position of the European economy. Unless the advantages of co-operation (cost and risk reductions) firms and scientific institutes are avoiding to collaborate due to different problems and barriers for co-operation (like trust, the complexity and problems to design and co-ordinate collaborations, apropiability of the results, different interest of firms and scientific organizations etc…).

The modern theories of technological change justifies public support on R&D, on one side for the generation of externalities for the innovation system as a whole (collective learning) and due to the fact that firms hesitate at the moment that co-operation offers some clear advantages.

For all these reasons, most developed countries have implemented devices for encouraging this type of co-operation. Indeed, at all levels of administration, policies have been devised to promote co-operation.[1]. Despite the large number of policies and programs developed in recent years, on very few occasions have they been assessed exhaustively.

In this article we wish to analyse whether these policies have achieved improvement in organising a system of innovation, by increasing interaction and collaboration between innovating agents. As a first step, the methodology and findings of existing assessment studies will be reviewed. The problem is that most of the evaluation studies are never been published, their existence is often not known, and many of them are not publicly accessible. Therefore only a few studies are included in this revision and most of them are Spanish ones. Anyhow these studies reflect quiet well the indicators used and give a good overview of the results or impact of the policies. Section two offers a critical review of the indicators and variables that were been used to measure the impact of the policies to foster co-operation and assessing the outcome of those studies. Therefore the last

[1] On European, national and regional level

section is an attempt to answer the question as to whether the policy of promotion has been effective or not, referring especially to the Spanish case. In the final part the main conclusions and some final comments will be offered.

2. - REVISION OF THE LITERATURE AND EVALUATION STUDIES

In this section, there is an analysis of evaluation studies that provide us with information on the impact of state aid on co-operation in the field of innovation. A critical view is presented regarding the indicators for some form of checking as to whether the instruments do or do not meet one of the main aims of aid; to increase the intensity and frequency of co-operation between the different agents of the innovation system

As mentioned previously, many policies have a dual aim: on the one hand, generating or spreading new technologies and, on the other, fostering co-operation. Therefore, the lack of or low level of co-operation is not always considered- by the agencies managing aid- as a problem or defect in the program, as long as other aims are achieved. Thus, assessment studies cannot just be limited to analysing the influence of policy on firms' co-operative attitude but, rather, for the policies to be justified, other achievements of the project have to be analysed. These are, for example, the importance of aid to be able to carry out the project, the generation of new technologies, cost savings, the learning process, the complimentary nature of activities, improving the organisation of the innovation system, etc.

Despite the importance of these aspects, in this work [2] special study is made of the programs' impact on co-operative attitudes.[3] Indeed, as shown in tables 2.1 the assessment studies have analysed a large number of aspects concerning co-operation. The variables used to analyse the success in encouraging co-operation can be classified into five basic indicators. The first three are based on direct questions –by means of questionnaires- to firms. The first basic indicator is based on the question of whether there has been an increase in co-operation or an improvement in co-operative attitude. The second registers the variables or questions that analyse the importance of aid for the firm to co-operate, and the following one analyses the importance of aid in carrying out the project.

These indicators are directly related to the projects that were supported. The following two are analysing the situation before or after getting the support. The first measures on an indirect way the impact of aid on co-operative activity. It study to what extent there existed a co-operative attitude prior to the subsidised project and, to what extent firms have previously collaborated with the same participants in the subsidised project. As a fifth indicator the consolidation of the co-operation as well as in supported like not supported firms was been analysed. Therefor as well as the supported firms as those firms who's applications were rejected were asked if they consolidate their co-operation once finished the co-operative project.

Albeit there appears to be a certain overlapping among some of the indicators mentioned the differences will be clarified in the successive subsections.

[2] For an analysis of the other aspects see: Molero/Buesa, 1995a and Heijs, 2000, 2001 and 2003
[3] Regarding the other aspects the studies used can be consulted. A very complete study is presented in Heijs 1999, 2000 or 2001.

Table 2.1: Evaluation of the impact on the co-operative attitude of public policies

BASIC INDICATORS	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
TYPE 1: INCREASE IN CO-OPERATION								
Increase in co-operation in general				Yes	Yes			
With public R&D organisations	Yes							
With firms	Yes							
TYPE II: IMPORTANCE OF CO-OPERATION FOR CARRYING OUT THE PROJECT								
Co-operation would have been unlikely or not very likely without public support		Yes				Yes		Yes
Without public aid firms would have developed the project by themselves						Yes		Yes
Why public aid was requested (Facilitates co-operation; to obtain funding or other reasons)						Yes		
The project would not have been feasible without the co-operation of a partner		Yes						Yes
TYPE III: IMPORTANCE OF FINANCIAL AID FOR CARRYING OUT THE PROJECT								
Additionality or freerider behaviour	Yes (1 ó 2 ó 3)	Yes						Yes
Without public aid firms would not have started the project			Yes		Yes	Yes		
The firm has replaced its own financial resources with public ones	Yes (1)							Yes
Without public aid the firms would have initiated a lesser-sized project or would have delayed it.		Yes	Yes		Yes	Yes		
Existence of alternative funding sources	Yes (2)							Yes
Importance of the amount of aid in general (GEN) or in comparison with the firm's total R&D outlay (GID)	Gen.(3)	Gen.			GID			
TYPE IV: PREVIOUS EXPERIENCE IN CO-OPERATION AND CRONYISM								
Those taking part in the project have previously collaborated		Yes	Yes			Yes		Yes
Those taking part in the project have previously participated in the same program (cronyism)			Yes					Yes
The firms have previously collaborated in the R&D field			Yes					Yes
Analysis of the firm's co-operative attitude in R&D in general	Yes	Yes		Yes	Yes	Yes		Yes
Analysis of the type of firm where the aid has had a lesser or greater impact on co-operative attitude	**	*	*	*		*		*
TYPE 5: CONSOLIDATION OF THE CO-OPERATION								
Consolidation of the co-operation after getting support							Yes	
Consolidation of the co-operation although the firm did not get support (analysis of the not selected firms)							Yes	
Co-operation is a requisite for the programs.	Yes	Yes	Yes	No	Yes	Yes		Yes

Source: Own elaboration from Molero/Buesa 1995a and Heijs, 2001 (Case 1); IESE, 1995 (Case 2); Vence et al, 1998 (Case 3) Siegert et al 1985 (Case 4); Reger/Kuhlman, 1995 (Case 5); Wollf et al, 1994 Case 6) Katsoulacos 1994 (Case 7); Heijs et all, 2004a (Case 8) .** indicates a broad study ; * it has only been studied in a simple form Note: It is worth mentioning that in cases 1 and 4 not only were co-operation projects assessed but also non-co-operative projects.

Prior to examining each of the indicators it would be worthwhile to emphasise a methodological problem, which is difficult to solve, regarding the direct questions of the first three indicators. As has been reflected in many studies (See, among others, Meyer-Krahmer, 1989; Becher et al., 1989; Heijs 2001, 2003) regarding direct questions, the firms surveyed are prone to overrate the impact or importance of subsidised projects[4]. Firstly, because in many cases, when asking for aid, firms must justify the need for it or the importance of the co-operation, and they do not like to confess that they have not been so important. Secondly, because firms are interested in maintaining the image of a successful aid program so that they can use it again in the future. As we have already said, this is a problem that is difficult to avoid in surveys. But, as we will mention later on, the simultaneous use of the different basic indicators could improve the reliability of the findings.

The first of the indicators for analysing the success-or otherwise- of promoting co-operation, used in three of the case studies (See Table 1), is based on direct-type questions where firms are asked whether there has been an increase in co-operation, or whether the co-operative attitude of the firm has improved or increased in the field of innovation. Regarding the interpretation of the findings, there not only exists the methodological problem, which has just been explained, stemming from direct questions, but also we would have to take into consideration whether increased co-operation is due to the very characteristics of the innovation project or, rather, is the outcome of state aid. Expressed in another way, would the same project have been carried out and in a co-operative way without state aid? Really, this question overlaps with the third basic indicator, thus, here the problem is merely raised and in section 2.1.3. it will be looked at more closely.

Table 2.2: Evaluation of the impact of public policies geared to technological co -operation.

	1	2	3	4	5	6	7	8
OTHER ASPECTS ANALYSED								
Type of activity or form of cooperation		Si				Si		
Type of partners		*	*			*		
Regional location of the partners			Si					
Criteria for seeking a partner						*		
Advantages of cooperation						Si		
Aims/reasons for cooperating		***	***			***		*
Barriers to cooperation		***	***			***		
Problems during cooperation		***	***			***		
Analysis of certain aspects of the administrative process for obtaining aid			*			*		
Project has been drawn up/designed by the firm or by a third party			*			*		
Coordination of the project		Si						
Technological and/or commercial findings		***	*					
Achievement of the aims	*	***	*					

Source: Own elaboration from Molero/Buesa, 1995a and Heijs, 2001 (Case 1); IESE, 1995 (Case 2), Vence et al, 1998 (Case 3) Siegert et al, 1985 (Case 5) Wollf et al, 1994 (Case 6) Reger/Kuhlmann (Case 7); Kulicke et al, 1997 (Case 8). The number of asterisks would have to be interpreted according to the depth or breadth of the analysis of the corresponding topic where * indicates simple analysis; ** broad analysis and*** exhaustive analysis

[4] For example, the Meyer-Krahmer study, 1989, indicated that by using direct questions in surveys the percentage of firms with a freerider attitude was somewhat over 30%. Subsequent interviews have shown that this percentage rises to 50%. It turns out that in a face-to-face interview businessmen are more open to self-criticism.

2.1.1. Existence of increasing co-operation

The works of Molero and Buesa (1995a, 1995b), IESE (1995) and Heijs (2000, 2001)[5] have assessed the impact of the subsidised projects, the subject of the empirical part of the third section. The studies made by Molero, Buesa and Heijs have asked directly if firms have increased co-operation. The findings of the study have shown that 12% of firms have not increased the intensity of their co-operation, 26% of firms have increased it significantly and 62% of firms consider that their attitude towards co-operation has shown a great increase. Anticipating the findings that will be presented in detail in section three, it can be indicated that firms who have increased their co-operative behaviour are, especially, the most innovating firms. The percentage of firms who have shown increased co-operation is very similar to what was observed in the study by Reger & Kuhlmann (1995), where it was shown that some 65-70% of firms have increased their "wish to co-operate". Although they do not give an exhaustive analysis of the profile of firms with a greater or lesser impact they indicate that no clear differences between large and small and medium-sized firms have been detected. The IESE study, specifically designed to analyse subsidised projects, did not analyse by means of a direct question concerning whether co-operation had increased with Public Research Organisations (OPI[6]). This study uses a Type II indicator asking firms if co-operation would have taken place without public aid. (See the next section).

2.1.2. The importance of co-operation for carrying out the project

The second basic indicator analyses the importance of the partner's co-operation (such as Public Research Bodies) for the carrying out of the project. This importance is frequently used as an indirect indicator to measure increases in co-operation. It is implicitly argued that if co-operation is very important for carrying out the project, an increase of co-operation will have taken place. However it is also debatable that if the partner's contribution is very important the firm would have also collaborated without public aid. That is, it will not have increased its co-operation. Neither does this variable analyse whether there exists a "net" increase in co-operation, since the fact that the partner is important could be related to previous co-operation between the firms and their partner (an aspect related to the fourth basic indicator). Examination of the case studies seems to reveal that this second indicator is used as a substitute for the first basic indicator-or viceversa-, since none of the studies used both basic indicators concurrently.

The direct questions-included in the surveys- used to measure the importance of co-operation for carrying out the project in the studies examined were:

1. Would co-operation have been unlikely or not very likely without public aid?
2. Without public aid would the firms have developed the project by themselves?
3. Would the project not have been feasible without the co-operation of the partner?

The fact that co-operation would have been unlikely or not very likely without public aid or that without public aid the firms would have developed the project by themselves (questions 1 and 2) could be an indication that the state has managed to encourage co-operation but, at the same time, indicates that the co-operation was not necessary in order to carry out the project. That is to say, in the short term co-operation would not bestow direct advantages on the subsidised project but it is assumed that in the long run better integration and greater co-operation between the agents of the

[5] This study is based on an analysis of 1354 firms who have received CDTI aid, of which some 35% had taken part in subsidised projects. The IESE study (1995) has only studied firms with subsidised projects.
[6] Organismo Público de Investigación

innovation system would improve the quality and efficiency of the technological and scientific activities in a particular area. That is because the prime aim of state aid is to improve the organisation of the national and regional innovation system.

The third question, would the project not have been feasible without the co-operation of the partner?, would have to be interpreted with regard to one of the aims of the public encouragement of co-operation. Such encouragement is justified if the co-operating subsidised firms are able to carry out R&D projects of a higher complexity or scientific base (for example, interdisciplinary projects) than they could carry out on their own. It is true that the interpretation of this question from the point of view of increased co-operation is not altogether unmistakeable. It might be asked if in the case where co-operation is important for implementing the project the conclusion can really be reached that public aid has fostered co-operation. Indeed, if a firm cannot carry out a project on its own and foresees important profits, it would seek, regardless of the existence or otherwise of public financial aid, alternative partners and funding.

This second basic indicator and the corresponding three questions, present two important methodological problems. The first is the problem of an implicit, correct interpretation of the questions or answers. It is worth highlighting the fact that collaboration as a consequence of aid does not automatically imply that the firm in question will improve its co-operative attitude or that in the long term it will increase its co-operation in general terms. As we shall see below, there are a large number of co-operative projects where co-operation is only a marginal or purely formal aspect, necessary for fund raising. Moreover, the questions do not clarify the reasons why co-operation would not have taken place if public funds had been lacking. It could be imagined that in this case the firms would carry out the projects on their own, but it also might be the case that they would not have started them without aid. A second methodological problem, akin to the one for the direct questions shown for the first basic indicator, is that the firms could be prone to overvaluing the importance of co-operation in carrying out the project.

Regarding the subsidised projects, the IESE study (1995) provides empirical results with respect to two of the questions of the second basic indicator. According to this study, and although 74% indicate that they had previously co-operated with the OPIs, a large number think that the co-operation would have been unlikely (18%) or not very likely (48%) without public support, whereas 34% would also have collaborated without state aid. Regarding the third question, the study indicates that 44% of the firms considered that the Centre's contribution to the feasibility of the project has been high (33%) or very high (11%) ,whereas 56% of firms state that the project would have been feasible or very feasible without the collaboration of the public research organisation. The differences in the understanding of feasibility, rather than the characteristics of the firms (size or innovating effort), seem to be related to the technologies developed in the project. Of particular importance is the role of the OPIs in long-running projects (56%), in projects which develop new methods (56%), or prototypes (62%) and less in projects of lesser importance or technological level.

A recent study of Heijs et all (2004a), pointed out that that 45% of the supported projects would be also feasible without the co-operation with the research centre, 20% would have initiated the co-operation also without support and 56% would have initiated the project also without public support. Using a combined indicator (in which the firms answer at least at one of those three indicators with yes) they found out that over 75% of the firms reflected indirectly that the support was not very important nor for initiating the project neither for co-operating (Heijs et all, 2004a).

Though the programs analysed for this article, such as the aid for subsidised projects, are aimed at increasing co-operation between firms and OPIs, the latter can be considered as a clear aim from the state's viewpoint, but it is not known whether firms view it in the same light. A method or indirect question revealing the importance of co-operation or aid for the project is the following. Why was public aid requested? If the reason for seeking aid was to obtain funds it could be argued that aid has increased co-operation. However, the requirement or the advantages generated for the project due to the collaboration are not clear and, even less demonstrated. In this case aid can only be justified by arguing that increased co-operation gives rise to long-term effects as a result of greater integration of the agents of the innovation system. In the case of subsidised projects (IESE,1995) 58% of firms have indicated that one of the motives leading them to co-operate with OPIs has been to fulfil the program's conditions for obtaining funding. It is worth mentioning that these were multiple-choice questions[7] and it is not possible to know what percentage of firms had this motive as the most important or determining.

Instead of analysing business opinions on the importance of partners or aid to carry out the project an indirect form of analysis could be made of the importance of co-operation or the partner, basing it on objective data from the projects, such as the total percentage of the cost of the project devoted or provided by the partners. In the case of the subsidised projects only in 25% of the projects did the OPIs carried out more than 18% of the budget and in 39% of projects less than 8%. It is noteworthy that the percentage of OPI participation is in inverse proportion to the project's total budget, so that the higher the budget the lower the OPI share (IESE, 1995). Acosta's study (1996) highlights a group of firms where the OPI contribution was almost non-existent. Regarding this group, (see Table 2.3: Group 1) it is significant that 70% of the projects of these firms have been carried out by just themselves. The most outstanding characteristics of these firms are; the large size of their R&D departments (more than 25 employees), the fact that they have 2 or 3 subsidised projects approved and the fact that they belong to the pharmaceutical and space R&D sectors. Firms with a higher OPI involvement in projects (Groups 2 and 3) are firms with a low level of R&D and firms in the sectors of agriculture and fishing, services to firms, extraction and transformation of minerals, chemicals and other manufactures.

Table 2.3 The role of Public Research Bodies in subsidised projects

Group and number of firms	% of budget of the total amount of support carried out by OPIs	Average budget of projects in millions of pesetas	employment	R&D expenditure	R&D expenditure by sales	R&D staff	R&D staff employed (%)	Outstanding technological sectors or fields
Group 1 (53)	1,0%	151,2	1,703	3,484	17,8	302	18	Space research and pharmacy
Group 2 (153)	9,4%	129,6	705	896	6,1	88	13	Agriculture and fishing and services to firms
Group 3 (130)	18,2%	98,7	1240	619	2,0	66	5	Extraction and transformation of minerals, chemicals and other manufactures
Group 4 (41)	50,4%	114,9	1,425	982	4,7	103	7	Robotic and other technology (Not including the space R&D sector)

Source: Own elaboration from Acosta, 1996 (Pages 294-307)

[7] The reasons for co-operating were access to the infrastructure (70%), acquisition of experience or know-how (70%), access to unavailable specialities (65%), fulfilling the requirements to obtain aid (56%), keeping up with technological breakthroughs (55%) and cost reduction (45%).

The group of firms where the Public Research Organisations (OPI) have a very important role is the smallest (Group 4). The characteristics of these firms are rather surprising , since they include relatively large firms with large R&D departments. For most of these firms (70%) their total R&D expenditures doubles the budget obtained from the government by the supported projects. All of this could suggest that, for firms in the fourth group, co-operation with OPIs does not appear to be really necessary. However, taking into account the technological fields –robotics and biotechnology- it could be that we are looking at costly projects, which are very complex or of high technological and commercial risk-in which scientists, that is the OPIs- can provide a substantial contribution by making available their large scale installations and specific know-how. Group 4 also includes small firms (fewer than 25 employees) with small R&D departments (fewer than 5 employees). These, according to Acosta, are those firms which do not reach the minimum threshold for R&D expenditure to be able to carry out basic R&D off their own bat successfully.

Concluding with a sectoral analysis, it can be indicated that firms with a marginal role played by OPIs are firms with high R&D spending and firms working in the following technological fields: new materials, space and pharmaceutical research, information telecommunications and pharmaceutical technology. However, there is also a group of small firms in the agricultural, fishing and services to firms sector, where OPIs had a much reduced role .OPIs played a more important part in firms with a low level of R&D and in the branches of mineral extraction and transformation, in chemicals and, finally, in firms in the sector known as other manufactures (Acosta, 1995).

2.1.3. The importance of aid in carrying out the project

The third basic indicator analyses the level of additionality or the replacement effect. Apparently this indicator is quite similar to the previous one but there is a clear difference in the interpretation of both. The Type II basic indicator measures the importance of co-operation in carrying out the project. In other words, to what extent the project is only feasible due to financial or technical contributions- from the co-operating partners. The type III indicator only assesses the importance of aid from the financial viewpoint, analysing whether the project would have been carried out –co-operatively or individually-if there had been no public funding. Where firms would have gone ahead with a similar-sized project without public aid one could talk of the replacement effect, replacing private financial resources with public ones-this being cheaper-with no increase in innovatory activities on the whole[8]. This indicator does not analyse the encouragement of co-operation in a direct form, but the existence of a replacement effect could suggest that aid does not foster innovation in general or, a more specific interpretation, the public support do not raise the co-operation between firms.

It is worth remembering the methodological problems regarding direct questions, that is the underestimate of the number of firms with a freerider behaviour. And second the use of slicely different indicators could lead to different conclusions. Heijs' study (2001/2003 and Heijs et all, 2004a), uses three different indicators to analyse the profile of firms with freerider behaviour and found out that the findings are different depending upon the indicator used. To find a partial solution to these two methodological problems Heijs (2001/2003 and Heijs et all, 2004a) a combined indicator has been used, which analyses the three indicators simultaneously. The

[8] This same phenomenon is also studied under the denominator of freerider behaviour or financial additionality, also known by the English expressions: freeriding, crowding-out effect, or financial additionality (For a broad discussion on this point see Heijs, 2001, 2003).

advantage of using different indicators and creating, on that basis, just a single combined indicator is that the firm has to exaggerate -that is to lie- regarding the importance of aid on three occasions.

The studies indicate that only a limited percentage (between 15% and 28%) of firms who have received funding for subsidised projects show freerider behaviour (Molero/Buesa, 1995; Heijs, 2001/2003), a percentage similar to that found in studies evaluating other programs (Heijs, 2001). The IESE study, which also analyses the subsidised projects indicates a lower percentage. According to this study, only 7.5% of firms indicate that there was no financial additionality, and this is a percentage well below that of other studies. Heijs et all (2004a), using a combination of three individual indicators, indicates a high level of freeriding (over 60 percent of the supported firms).

2.1.4. The co-operative attitude prior to the subsidised project and cronyism and the consolidation of the co-operations in the future

Another indirect form of analysing the impact of aid on co-operative attitude would be to study to what extent there existed a co-operative attitude prior to the subsidised project, to what extent the firms have collaborated previously with the same participants in the subsidised project, and how much a certain "cronyism" (defined as the high frequency of participation of the same clients in the different or even the same support schemes) can be detected in the awarding of aid. In fact, the aim of the aid, with regard to co-operation, would be to stimulate the start up of collaboration in innovating firms which had not hitherto collaborated, or strengthen the co-operative attitude of the innovating firms. To discover whether these aims have been fulfilled it would be a good idea to assess the "net" effect of the policies, both with regard to the previous co-operative attitude to the subsidised project, and to study whether those participating in the projects had co-operated-among themselves-on a previous occasion.

In fact, as shown by the IESE studies, (1995) and Vence et al (1998)-many firms obtaining aid for co-operative projects have previously worked with the other participants. This fact is logical if we bear in mind the difficulty of designing, carrying out and coordinating, with no hitches, an innovation project based on co-operation. If innovation in itself is already a complex activity, innovatory co-operation would mean an extra difficulty. The integration of complementary activities of each of those involved is difficult even when there is an explicit agreement on the aim or final outcome of the project. But there is not always such an agreement, since each firm or agent has his own aims and interests. A case that serves as an example of this problem is co-operation between firms and universities, where the latter usually works at a much slower pace, and frequently does not meet the deadlines established and where the primary aim of academic scientists is to have the findings published. On the other hand, firms prefer a project to be developed discreetly- to avoid copying by other firms-and well planned so they can calculate potential costs and profits. Another of the problems regarding the fostering of co-operation is the reluctant attitude of firms over co-operating with other agents, particularly in the case where it is a question of the firm's strategic technologies or projects with unknown participants. Distrust over possible partners is one of the barriers to co-operation which is most difficult to overcome and once a relationship exists based on trust firms would rather continue to co-operate with the same partners instead of extending the group of collaborators.

Another aspect directly related to the attitude of co-operation prior to the subsidy is "cronyism" in approving the projects. It might be assumed that a large number of firms repeating their participation in the same or similar programs -the cronyism effect- would lessen the impact on the

fostering of co-operation or collaboration. With regard to the subsidised projects, the IESE study indicates that 77% of the firms had previously collaborated with OPIs, of which 45% were in subsidised projects, and 27% in European projects. The percentage of firms which had not co-operated previously with OPIs is particularly high for small firms(35%) and those in the food sector (51%). The study by Vence et al (1998), which analyses Spanish firms' participation in the European Union FRAMEWORK Program, indicates that the agents which had taken part in the third Program showed a high level of previous collaboration with other agents, a situation which appears to favour their integration into community R&D, characterised precisely by its consortium activity. The authors state that they do not know whether this previous co-operation was in prior editions of the FRAMEWORK Program, though it might be assumed that the degree of repetition was very high. In both cases it might indicate that this Program would be more of a support or cover to extend the bases of an already existing collaboration than an extension of the number of co-operating firms. This fact is also noted by analysing the percentage of firms who have presented more than one project. 66% of firms are included in more than one project and 32% in more than five. Moreover, 56% have presented proposals in cases where official announcements have invited them at both regional and national level[9]. This would reflect the learning process which involves the difficult process of defining, presenting, and managing the projects. All this points to strong concentration of public aid devoted to co-operative projects. Both in European and national and regional projects not many agents participate, but those that do participate in several projects (Vence et al, 1998). A recent study of Heijs et all (2004a) confirms this conclusion regarding a high level of "clientelism", almost 80 percent of the supported firms did participate in the same or other similar programmes.

Due to the phenomena of previous experience in co-operation and cronyism it is not always possible to analyse with the accuracy one would desire the "net" influence of the policy on their co-operative attitude. In fact, a number of participants, albeit small, who have started their first co-operative project would be an indicator of success. An indirect way of measuring the intensification of co-operative attitude could be to find business opinion on the co-operative experience, particularly for firms who do not normally co-operate or do so infrequently. The percentage of firms who give a positive evaluation to co-operation or who state that they intend to co-operate again in the future could be a "soft" indicator to value the impact.

Katsoulacos 1994 introduces a fifth type of indicator analysing consolidation of the co-operation. On one side, the consolidation of the co-operation after getting support and on the other side the consolidation of the co-operation although the firm did not get support. The first variable –which analyses the short o medium term effect of the support- indicates that 45% did not have following up co-operative activities with the same partners after finishing the project. The second variable analysed by Katsoulacos indicates if the not selected firms, after investing a certain amount of time, money and human capital in the preparation of the rejected proposal –probably based on common interests and goals-, carry it out anyway or do decline to go on with it. Almost 50% did carry out the project anyhow. On one side, this variable could indicate an effect of the policy even for the not supported firms. Although from the other side it could mean that most firms decide first to co-operate and afterwards to ask for financial support. In this case the support would not have promoted the co-operation.

[9] This study has also analysed the complementary financial funds. Respectively 23 and 40 per cent of firms state that they have obtained funds from regional and state governments. 6% from the university and 7% from Public Research Bodies. (These are not mutually exclusive percentages, which implies that the same firm could have obtained funding from different sources at the same time.

The difficulty to interpret the different indicators and their possible meanings underpin again the necessity to work with different complementary indicators and use them to create combined indicators.

2.2.-General assessment of the evaluation studies [10]

In general, evaluation studies, systematically revised for this article, have analysed the impact on co-operation, in a broad sense but, as can be seen, very diverse indicators have been used, so the findings are difficult to compare. As already indicated, the aim of financial aid would be to stimulate the setting up of co-operation on the part of innovating firms who have never previously collaborated, or to strengthen co-operating activity by innovating firms who have already collaborated. To discover if these aims have been met it would be worthwhile to assess the "net" effect of the policies. This "net" effect is difficult to measure, firstly, because the "co-operative culture"- which should be measured before and after the incentives offered by public aid have been applied- is an intangible concept. It is very difficult to measure the improvement in this culture –in the short term-by means of qualitative indicators and it is nearly impossible to measure it in quantitative terms or analyse the effects of the policies on the organisation of the system of innovation in the long term. In fact it is very difficult to isolate the policy effect on the changes in the co-operative culture of the innovation system in time from other possible explanatory factors on that influence that culture. Therefore, and due to the existence of cronyism and previous experience in co-operation, an analysis cannot always be made with the desired accuracy of the net effect of the policy on attitudes to co-operation.

A general criticism of evaluation methods, analysed for this work, is that they have not made an exhaustive, simultaneous analysis of whether firms would have started the project and the co-operation as well without state aid. Nor has a broad analysis been made as to the extent to which co-operation was more of an imposition because of state aid received rather than a necessity due to the firm's lack of innovatory capacities. That is to say, there are co-operation-based projects which could have been carried out –in the same way- without public aid and there are projects where co-operation was not necessary but was agreed upon in order to obtain the aid. The fact is, that to analyse accurately the impact of the policy three questions would have to be answered affirmatively and simultaneously. Firstly, would the project have got under way without public aid? Secondly, would co-operation not have started without state aid? And, thirdly, would the project not have been feasible (or would it have been much more expensive) without the co-operation of other agents in the system of innovation?

In any case it must be admitted that evaluation of the policies to promote innovation is complex, since there is no comprehensive theory of technological change and economic development that includes the role of the State (Nelson/Winter, 1982; Nelson., 1984 Dosi/Freeman/Nelson, 1988), neither is there a microeconomic model which incorporates the role of innovation policy (Capron, 1992; Heijs, 2001) or the importance of co-operation in this field. The lack of such a theoretical framework, which could serve as a reference for interpreting the findings, implies that the only way of checking the reliability of the studies would be by means of a comparison of the findings of different empirical studies. Only the consistency found in different studies could ensure that the

[10] The global findings of the impact on co-operation –found in the case studies-will be presented in the final section of this article.

empirical proofs found are not "ad hoc" but correspond to an established pattern. As can be deduced from the methodological discussion, it is difficult to analyse the "net" impact and there is no homogeneity among the indicators applied. The lack of an explicit agreement among the assessors on the use of standard methodologies and indicators clearly impairs the influence of the studies upon the design and adjustment of the political instruments (Heijs, 2001).

This situation not only implies that the different studies are hardly comparable among themselves-which complicates the learning process from the experience of others-but, what is more, the use of different indicators to measure the same aspect can lead to different conclusions and ad hoc interpretations. Like already mentioned the difficulty to interpret the different indicators and their possible meanings underpin again the necessity to work with different complementary indicators and use them to create combined indicators.

Except for the study of Heijs (2000/2001) no other study has created combined indicators to partially correct the reliability and consistency of the findings. Those evaluating innovation policy still have to seek a compromise to achieve a standardisation of indicators and a great deal of creativity is needed to reach a set of indicators which are reliable and generally accepted.

A last comment can be made about the econometric studies. In the last years a few studies analyse the influence of public policies using different kinds of regression models. All the studies identified for the revision of the literature carried out in this paper indicates that public support augment the probability of cooperation in R&D (See Belderbos et all (2003) Mohnen et al (2003), Bayona et all (2003/2001), Miotti et all (2003), Busom/Fernandez Ribas 2004 y Heijs et all, 2004b/2004c). However the real importance of the support is not clear. These studies do analyse the augment of probability to co-operate but do not analyse the intensity or the propensity of co-operation. The empirical studies revised in this section do indicate that the effect on the probability to co-operate seems to be small. However we do still not know if the support augments the number of co-operative activities of the already co-operating firms.

3.- REVISON OF THE LITERATURE: RECAPITULATION AND CONCLUSIONS

In this article studies have been examined if the policies fostering the co-operation in the field of innovation do really augment such behaviour. For this purpose I have analysed the indicators and summarised the main conclusions of several case studies.

The findings-reflected in the examination of the evaluation studies- appraises, on the one hand, the impact of public aid fostering co-operation among the agents of the innovation system as very positive. The studies that used indicators based on direct questions show that increase in co-operation has been widespread-in nearly all the subsidised firms-and has been considered as very intense by a large number of firms (Molero/Buesa, 1995, Reger/Kuhlman, 1995, Heijs, 2000/2001). State aid has been very important for firms, since many subsidised projects could not have been carried out without state funding (Molero/Buesa, 1995; Heijs,2001) and the co-operation would have been-without state funding-unlikely or not very likely for 64% of firms (IESE, 1995). Furthermore, 44% of them state that the project would not have been feasible without the participation of partners (IESE ,1995).

But, on the other hand, these highly optimistic findings are not altogether free from suspicion. Firstly, because all the case studies use direct questions based on surveys and, as has already been indicated, firms are prone to overrate the impact of aid to satisfy the politicians in charge. A

second critical comment regarding the positive findings derives from the non-survey-based indirect indicators, the findings of which do not point to such a successful and indisputable impact. As already mentioned, the subsidised projects are especially designed to foster co-operation, the increase of which is a very important target in granting funding for the projects. For firms, however, this requirement is just a formality and indeed co-operation has not always been necessary to carry out the project, so firms may have co-operated without co-operation having increased in real terms, for example, through the allocation of marginal tasks to Public Research Organisations (OPIs) where these R&D centres carry on certain activities without this being able to be called co-operation but, rather, the hiring of services. In fact, there are a large number of subsidised projects, financed by the Spanish National R&D Plan, in which the role of public research centres is practically non-existent (14%) or marginal (40%) (Acosta, 1996). What is more, the majority of firms with subsidised projects (77%) have co-operated previously and almost half of them in subsidised projects. The studies by Vence et al (1998) and Heijs et all, 2004a, also indicates a high percentage of firms who have co-operated before and a high level of cronyism. These studies indicate a strong concentration in co-operative projects –both European and regional and national-where few agents participate but those who do so participate in several projects. Therefore, probably there exists a high degree of probability that we will find the same agents in the programs of different administrative levels, which once again would show a high level of cronyism. (Vence et al, 1998). This in turn complicates the measurement of the net increase in co-operation. In fact, only small number participants have begun a co-operative project for the first time due to public aid could be an indicator of success.

Another problem of the existing studies is the lack of an exhaustive, simultaneous analysis to find out whether firms would have started the project and co-operation as well without state aid, nor has there been a broad analysis of the extent to which the co-operation was more an imposition due to state aid rather than a necessity due to the firm's lack of innovatory capabilities. Moreover, most of the studies analyse two or three of the basic indicators of the firm, but none analyses it in a combined way. If each indicator expressed a group of firms in which the impact is less the overlap between these groups would have to be studied by analysing them simultaneously. In fact, what is missing in the studies examined is a rigorous examination of the "net" effect of the impact on the co-operative attitude by simultaneously using the different indicators.

To sum up, although it appears that the impact of public aid is positive it turns out that the conclusions of the studies are not altogether unambiguous. One side, direct questions (based on surveys) offer optimistic results about the impact of the public support on the co-operative behaviour of firms. Although indirect questions or additional data do suggest a less positive impact.

The final conclusion could be that the policies focused on co-operation mostly do deepen or intensify the existing collaborations of the firms already involved in co-operations. While the amplification of the co-operative attitude by non-co-operative firms is less successful. A similar conclusion we found by the instrument of financial support of R&D in enterprises. These support measurements deepen the innovative activities of already innovative firms and none of the supported firms initiate innovative activities due to the public support (Heijs, 2001/2003). The political agencies should design an instrument that not only deepens activities of the existing innovation system, but also broadens the number of firms that innovate and collaborate.

Moreover, the studies examined have not analysed the net effect that compares the co-operative attitude prior to the project in comparison to after it, nor does it take cronyism into account. In any

case, it is worth highlighting that the analysis of the impact on co-operation is not the sole aspect to assess in order to justify public aid. For the correct interpretation of the findings it would have to be recalled that for many programs the promotion of co-operation is only one of the aims and, on many occasions, generating highly innovatory technologies is considered as an aim which is just as important or even more so.

It is not easy to analyse the advantages or benefits in the long term or from the viewpoint of social welfare. It could be imagined, on the one hand, that co-operation improves -due to the financial, commercial or technological advantages- firms' performance, in which case they would also co-operate without state aid. On the other, if firms only co-operate to fulfil the aid requirements, co-operation has no direct advantage for firms involved and would be more likely to serve to support- or indirectly subsidise through contracts-the public research bodies. In these cases it could be possible that the public research organisation do marginal and/or isolated parts of the project in which mutual learning of both partners is not assured[11]. In both cases the increase in social welfare should be generated in an indirect way. The promotion of co-operation could be justified, by basing it on the theory of innovations systems. According to this theory-based on a holistic concept- the system creates synergies due to the interaction between its agents who, at the same time, generate a collective learning process. Evaluation studies do not analyse whether a process of collective learning or synergies is generated, but analyse the increase in co-operation and reason that the existence of such an increase would generate, like an invisible hand, a better working of the system as a whole. This way of evaluating the policies is due to the difficulty involved in analysing the increase in social welfare, since it is almost impossible to analyse the net increase in co-operation and the indirect effects on the innovation system.

In spite of the methodological problems mentioned in regard to the evaluation studies, it has not been my intention to discredit them completely. Indeed, most of them can be classified as fairly complete studies and with a well-developed methodology and internal logic. It should not be forgotten that evaluation studies as a scientific activity are, especially in Spain, a relatively new activity. The lack of a global, integral theory which might explain all the relationships between technological change and economic dynamics and which would include the role of the State is an inevitable problem which, in principle, would have to be solved before studying the role and the suitability of different instruments of technological policy. But the agents, responsible for technological policy, demand solutions to improve the efficiency of their performance and cannot wait until all the relationships between technological change and economic development have been determined. Therefore, evaluation of the instruments is no less important and it should be based on existing theories, since studies with a proven methodology, carried out in a professional manner, could generate important information-albeit not always unambiguous- for policy planners and for those in charge of decision making. The direct usefulness of these studies depends to a great extent on not only the quality of the studies but also the resistance of those politically and administratively responsible to apply the conclusions. Their usefulness in a broader sense depends to a great extent on their being published. The vast majority of the examinations carried out hitherto are not officially published and have become "grey literature" (Meyer-Krahmer, 1989; Heijs 2000/2001). Most of the reports are difficult to obtain since many of them have not been published and, even, in many cases the existence of these examinations has not been made known. This implies that the assessors lack a great deal of information which might help them to improve

[11] In fact both studies Heijs (Heijs, 2001/2003 and Heijs at all, 2004) indicate that the firms identified as being "freeriders" do reflect less frequently a learning effect of the supported projects and if they exist they are considered as less important.

the design of their studies, check and interpret their findings and, finally this obscurity complicates a collective learning process with regard to assessments.

4.- IMPACT OF THE SUPPORT FOR CO-OPERATIVE PROJECTS IN SPAIN

4.1 Introduction

After the review of the theoretical and empirical literature I will present in this section new empirical evidence for the Spanish case. At the end of 2003 we carried out a survey (the IAIF/FECYT database) to analyse the impact of public support for co-operative R&D projects answered by 505 firms of the total of 1562 enterprises that received support. The projects receive financial aid from the Centre of Industrial Technological Development (CDTI) and require co-operation between firms and public or private research institutes. The survey included questions related to the basic characteristics of the firm, its innovative behaviour and a set of questions focused on the evaluation of the impact of the support scheme. A broad range of variables (questions) was used to evaluate the impact of public support which can be summarised in five basic indicators. The first two indicators reflect objective data of the firms' co-operative attitude and participation in similar support programmes. The first one reflects the answers on two questions: does there exist previous experience in co-operation with the same institute involved in the subsidised project? or do you have previous experience with other research institutes?. The second basic indicator reflects the clientelism of the programmes, e.g. did the supported firms participate in other or similar programmes (distinguishing regional, national or European programmes) that promote co-operation in innovation? The next two basic indicators do reflect -instead of objective data- the freerider attitude measured by the personal opinion of the supported firms, both from a co-operative perspective e.g. lack of increase in co-operative activities (4 questions) and from a financial perspective (3 questions). This last basic indicator tries to identify the firms that would or could have carried out the project even without support. A fifth indicator -based on only one variable- reflects the technical feasibility of the project in the absence of the co-operation partner. Moreover the survey analysed the learning effects both for the firms and for the research institutes (see section 4.3)

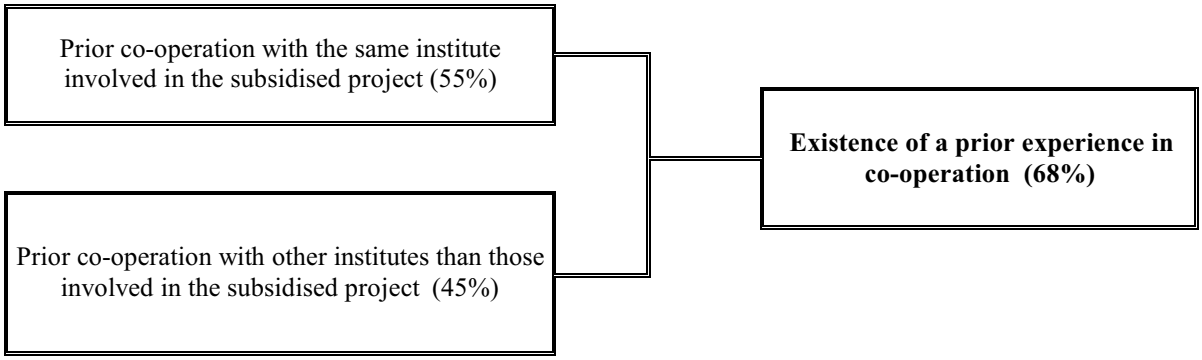
4.2 Impact on the co-operative attitude

In this sub-section I offer a description of the main tendencies regarding the impact of Spanish policies that promote co-operation in innovation. The literature shows us that that the size and the innovative behaviour are the most important variables to explain freerider conduct (Heijs, 2003) and the propensity of participation in the programmes (Heijs, 1999/2004e). In particular large firms and those that do not have a clear innovation strategy are more prone to be freeriders and participate more often in co-operative projects or public aid programmes (Meyer-Krahmer, 1989; Kulicke, 1995; Heijs, 2000/2003). Therefore we present in this section the data of the contingency tables crossing each of the basic indicators with four intervals of size and of the R&D intensity defined as the R&D expenditures by sales (the tables are included in the appendix). Section 4 will analyse more broadly the profile of the firms that are more influenced by the public support schemes than others. Therefore I will estimate a logistic regression model including a broad number of possible explanatory variables.

The first indicator (see scheme 1) shows that 68% of the supported firms had experience in co-operative innovation prior to the subsidised project. In fact, 55% of the supported firms had already co-operated with the same institute involved in the project and 45% had prior co-operation

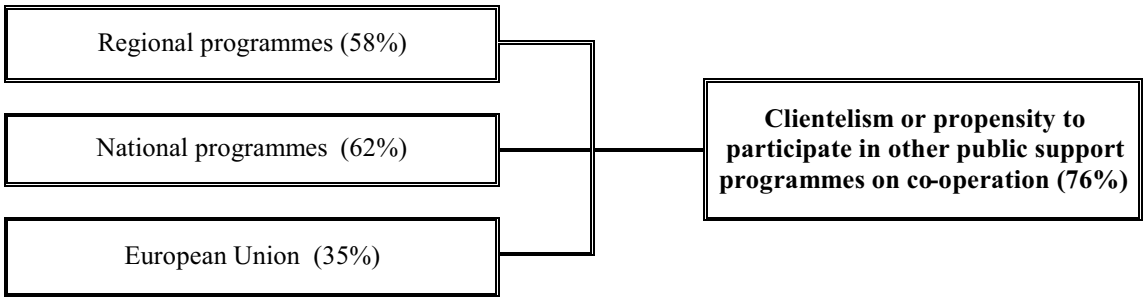
with other research institutes. This means that for almost 70% of the supported firms co-operation is not a new element of their innovation strategy. For these firms it is only possible that the public support will strengthen its co-operative attitude because they are already collaborating firms. So the data of the IAIF/FECYT database shows that only for a maximum of 21% of the firms could the incentive perhaps have generated co-operation in non co-operative firms. However, in both cases a large number of those firms would possibly also have initiated the co-operation without public support. Therefore I analysed -on this question- the opinion of the managers of the supported firm.

Scheme 4.1
INDICATOR I: Existence of a prior experience in co-operation



The data of diagram 4.2 shows us a high level of Clientelism, e.g. a high propensity to participate in other similar public support programmes on co-operation in innovation. Over 75% of the firms indicate that they participate frequently in similar programmes. Most of them participate at the same time in national and regional programmes (around 60% of the firms) while 35% of the supported firms also participate in European programmes that promote co-operation in innovation. Analysing with more detail the overlap between support measurements we can indicate that only 24% did not participate in any other programme, 23% of the firms participated in some other programme, 30% obtained funds of at least two administrative levels and another 24% obtained support from each of the three administrative levels.

Scheme 4.2:
INDICATOR II: Clientelism
(Participation in similar public support programmes that promote co-operation in innovation)



So we can conclude, on the one hand, that most of the supported firms have prior experience in co-operation in innovation, and, on the other hand, it can be stated that there is a high level of clientelism. Analysing both variables simultaneously we found that only 14% neither co-operated

nor participated in public programmes before getting support. This fact reduces clearly the possible impact of the support scheme and its effect basically will be limited to already co-operating firms. Thus the promotion of co-operation in non- co-operative firms probably is marginal.

Large firms (over 500 employees) especially more frequently have prior experience in co-operative projects (see appendix table 1); only 13% of those firms did not have previous experience in co-operation in innovation, while for the smallest firms this percentage is 40%. Moreover, they more often participate simultaneously in several public support programmes, except in the case of the regional support schemes. Taking into account R&D expenditures by sales of the firms we observe that the firms with an intermediate R&D level are the ones that mostly collaborated previously with the same institute currently involved in the publicly supported project. However the differences are small and no statistically significant relationship was found between the global combined indicator of prior co-operation or with the level of clientelism.

The third basic or combined indicator analyses the freerider attitude from a co-operative perspective. As already mentioned 55% had prior co-operation with the same institute involved in the subsidised project; for 20% of the firms the co-operation also would have occurred without public support; for 56% of the supported firms the project would also have been initiated without public support and for 45% of the firms the project would also be feasible without public support. Analysing these four questions simultaneously (see diagram III) we estimate that for over 80 percent of the firms public support had almost no influence on their co-operative attitude.

The fourth combined indicator analyses the freerider attitude from a financial perspective. The variables of this indicator reveal the potential financial additionality generated by the support schemes. Looking to the different variables of what constitutes the combined indicator (see diagram 4) we observe that 11% of the firms would have few difficulties in financing the project without support, 45% of the firms substituted the initially foreseen private investments by public money and 28% of the firms would have initiated the project also without support. Each of these variables could be interpreted as an indicator that the firms would or could also have carried out the project without support. So I constructed a combined indicator that indicates that over 60% of the firms probably could or would have performed the same R&D activities without support.

Tables 4 and 5 of the appendix show that the larger firms are more prone to a freerider attitude, both from a co-operative and a financial perspective. The R&D intensity of the firm (R&D expenditures by sales) is not strongly correlated with the freerider attitude although the firms with a medium level of R&D intensity are slightly more prone to a freerider attitude from a co-operative perspective while the firms with a lower R&D intensity are more prone to be freeriders from a financial perspective. However in both cases the differences are, although statistically significant, not very important.

The last (5^{th}) indicator analyses the technological feasibility of the project without co-operation. The data of the IAIF/FECYT database shows that for 42% of the projects there was no technical need to co-operate. No statistically significant differences were found for size or R&D intensity (See appendix table 5).

Diagram 3:
INDICATOR III: Freerider attitude from a co-operative viewpoint
(Indirect indicator that could reflect the lack of increase in co-operation)

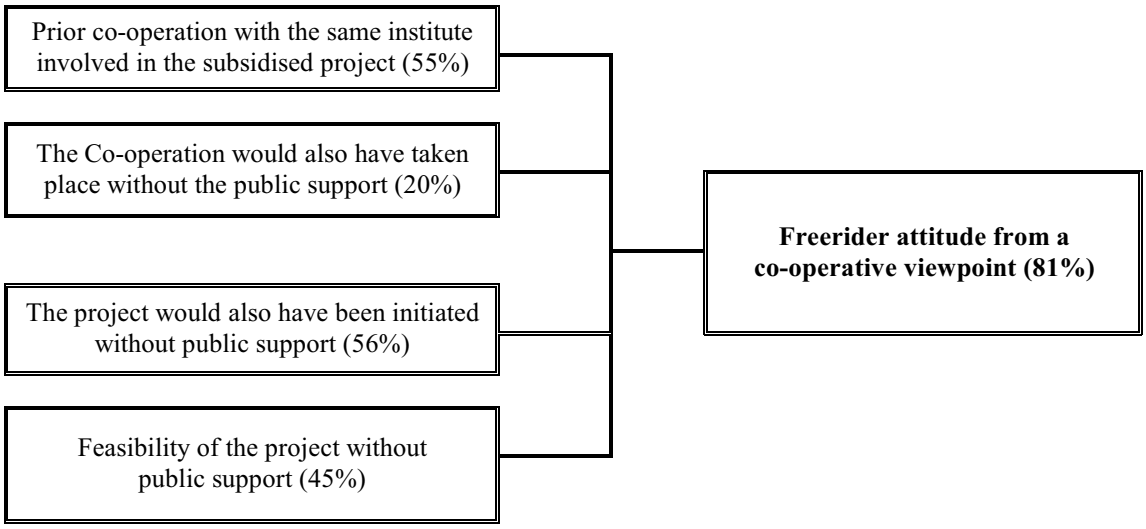
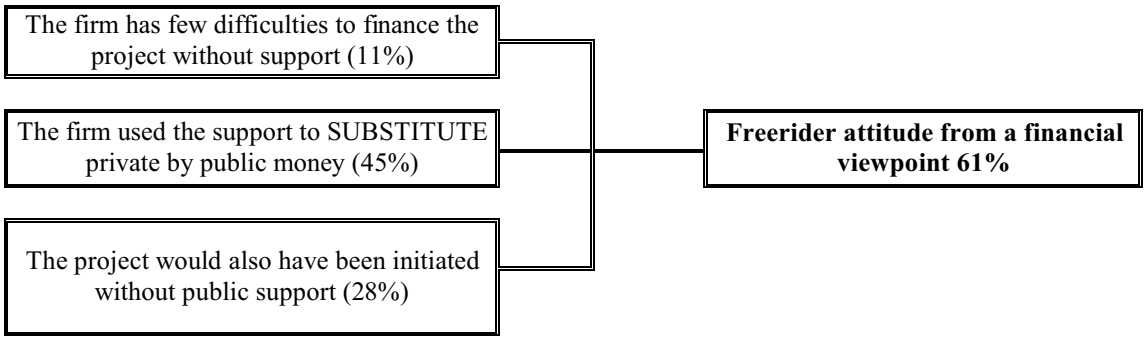


Diagram 4.4:
INDICATOR IV: Freerider attitude from a financial viewpoint



The main conclusion of the first part of the paper (section 2 and 3) is the presumably low impact on the co-operative attitude of the firms. The public support schemes apparently do intensify or strengthen the co-operative behaviour of already co-operative firms. However, they scarcely generate new collaborative attitudes in non-cooperative enterprises. A similar conclusion was reflected in the literature that evaluates the financial support of non-co-operative R&D in enterprises. They strengthen the innovative activities of already innovative firms and hardly any of the supported firms initiate innovative activities due to public support (Heijs, 2001/2003). The political agencies should design a instrument that not only strengthens activities of the existing innovation system, but also increases the number of firms that innovate and collaborate. In any case, it is worth highlighting that the analysis of the impact on co-operation is not the sole aspect to assess in order to justify public aid. For the correct interpretation of the findings it would have to be recalled that for many programs the promotion of co-operation is only one of the aims and, on many occasions, generating highly innovatory technologies is considered as an aim which is just as important or even more so.

4.3 Impact of the polices: learning effects

The IAIF/FECYT survey also provides us with information about the learning effects. The firms were asked about the importance of the technology transfer, in the form of knowledge and information flows.

Table 4.1 Impact of the public support projects on form of learning

		Transfer of knowledge and information to the research centres			
		Not important	Important	Very important	Total
Transfer of knowledge and information to the Firms	Not important	16	8	7	31
	Important	8	20	8	36
	Very important	5	4	24	33
	Total	29	32	39	100

Own elaboration on the IAIF/FECYT survey. * It is important to notice that the learning effects for the research centres were measured by the opinion of the firms

Table 4.1 indicates that 33% of the firms consider the knowledge acquired from the coo-operation partner of the projects as very important, 37% consider this type of technology transfer important and 30% estimated the learning effects as not important. On the other hand the firms consider that they transferred very important knowledge and information to 39% of the research institutes, another 32% transferred important knowledge and for 29% of the research institutes the learning effect can be considered as minimal. Analysing simultaneously both directions of technology transfer we found that for 16% of the projects there was no knowledge transfer at all. In these projects neither the firm nor the research centre seems to be involved in an important or very important learning process. For 56% of the firms there was an intensive mutual transfer of knowledge -considered as important or very important-. For the other 31% the transfer was in a one way direction. An interpretation of these results could be that for 56% of the firms the policy meets their objectives in creating synergies by a process of mutual or collective learning between firms and other agents of the innovation system. For 31% the learning process is individual while for 16% there is no learning effect.

Table 4.2.
Direction or orientation of the knowledge transfer (learning) between firm and research centres by type of firms (R&D intensity and size)

Size of the firm	Level of R&D intensity	The transfer of knowledge from the research centre to the firm is higher		Equal level of learning	The transfer of knowledge from the firm to the research centre is higher	
		Clearly	Moderately		Moderately	Clearly
Small	low	12%	14%	53%	12%	10%
	Medium/high	7%	1%	55%	14%	23%
Medium	low	10%	7%	59%	11%	14%
	Medium/high	9%	14%	48%	18%	11%
Large	low	13%	8%	59%	12%	8%
	Medium/high	7%	10%	57%	20%	7%
Total		10%	9%	55%	14%	12%

Own elaboration on the IAIF/FECYT survey. * It is important to notice that the learning effects for the research centres were measured by the opinion of the firms

Also the direction of the technology transfer was analysed[12]. Twelve percent of the firms indicate that they received -in net terms- clearly more knowledge and information than they transferred to the research centres while another fourteen percent also consider that they have learned rather more than their partners. E.g. 26% consider that they have learned more from the research institutes than these institutes have learned from the firm. While the opposite situation -the research centres are net receivers- was reflected for 20% of the cases. In 10% of the cases the research centres clearly learned more from their co-operation partners while for 9% their learning advantages were more moderated. In particular the smallest low-tech firms are the net receivers of the scientific and technological knowledge (26%), while in only 7% of the small high tech firms were the received flows of knowledge and information higher than the transferred technologies. The opposite situation -the research centres are net receivers- was found for 37% of the small high tech firms and only for 20% of the small low tech ones. For the other subsamples of firms no statistically significant differences were detected.

Former studies of the Spanish case (Heijs, 2000/ 2003) indicated that the learning effects are less in the case of the freeriders from a financial perspective. This is an important fact because it conflicts with the idea of the evolutionary theory that a certain level of freeriding can be accepted if there are other wider effects that make the subvention profitable. This argument to justify the policy would be erroneous in the event that the freerider enterprises show fewer wider effects and therefore the avoiding of freeriding should receive even more attention from the policy makers.

Consequently a final aspect of the learning effects that will be analysed is their correlation with the different basic indicators of the impact on the co-operation and the freeriding attitude. Tables 4.3 and 4.4 show, on the one hand, that the firms with prior experience in co-operation and that frequently participate in public support programmes show a lower level of learning. On the contrary, especially in the case of firms for which co-operation is relatively new, the learning effects seem to be higher. On the other hand, freeriding from a co-operative or a financial perspective is not statistically related to the learning effects.

Table 4.3 The importance for the transfer of knowledge from the firm to the research centres

		Importance of the learning effects for the research centres*		
		Low	Medium	High
I. Prior experience in Co-operation (99%)	Yes	13	53	34
	No	28	42	30
II. Clientelism (ns)	Yes	14	51	35
	No	26	44	30
III. Freerider from a co-operative perspective(ns)	Yes	17	52	31
	No	20	40	40
IV. Freerider from a financial perspective (ns)	Yes	17	53	30
	No	17	45	38
V. Feasibility of the project without co-operation (99%)	Yes	23	52	25
	No	14	47	39

Source: own elaboration based on the IAIF/FECYT survey. *Based on the opinion of the firms, Within brackets the level of significance in percentage (ns = not significant)

[12] Therefore we compared for each firm the value of the importance for the received and the transferred knowledge and information

4.- Profile of the firms with a lower or higher impact: an econometric model

In this part of the paper we analyse more broadly which type of firms are more influenced by the public support measures and which kind of firms could be characterised as freeriders. For this purpose we estimated logistic regression models. First we divided the sample between firms with a low level of impact compared to the ones with a high impact and secondly we estimated the model (see table 4.2).

Table 4.4.- The importance for the transfer of knowledge from the research centres to the firms

		Importance of the learning effects for the enterprises		
		Low	Medium	High
I. Prior experience in co-operation (99%)	Yes	11	46	43
	No	37	35	29
II. Clientelism (99%)	Yes	13	45	42
	No	35	34	31
III. Freerider from a co-operative perspective (ns)	Yes	19	43	38
	No	21	39	40
IV. Freerider from a financial perspective (ns)	Yes	20	41	39
	No	17	44	39
V. Feasibility of the project without co-operation (98%)	Yes	24	48	28
	No	15	28	47

Source: own elaboration based on the IAIF/FECYT survey. Within brackets the level of significance in percentage (ns = not significant)

As already shown in the former section, the large firms more often had had prior co-operation, participated more often in several programmes at once, and have a higher likelihood of being freeriders, both from a co-operative and a financial perspective. However the question is if this relation ship is the result of their size or, otherwise, could be related to other characteristics of the large firms. The results of the contingency tables and the corresponding association tests presented in section 2 are easy to interpret, albeit they do not take into account the interaction between independent variables. Sometimes the association that seems to exist between freeriding and size could be caused by a third variable (apparent relationships), example sectoral differences in size. Therefore I introduced a second statistical analysis based on a logistic regression model. This method takes into account the simultaneous effects of the independent variables on the variable to explain.

Table 4.1 Motives to co-operate with research centres

	IMPORTANCE			
Motives	Low	Intermediate	High	Total
Saving or reduction of costs	39	33	28	100
Obligation to obtain public support	30	35	35	100
Access to specialities and qualifications not available in own firm	22	32	44	100
Access to infrastructure and equipment not available in own firm	22	29	44	100
Following up of technical advances	23	37	40	100
Acquiring of experience and knowledge	18	38	44	100

Taken from Heijs et all, 2004b

4.2. Profile of the type of firms with a low or high level of impact: a logistic regression model

	Prior experience in co-operation		clientelism		Freeriding from a co-operative perspective		Freeriding from a financial perspective	
	1	2	1	2	1	2	1	2
Size	+++	+++	+++	+++	+	++	+	+
Export propensity								
Age of the firm								
Individual enterprises (reference category)								
Enterprise of a national group							+	+
Foreign enterprises								
Producers of traditional consumer goods								
Providers of traditional intermediate goods				-				
Providers of specialised machinery and equipment								
Scale intensive sectors and mass assemblers								
Science based sectors								
Other manufacturers					+	+		
High tech services								-
Other services (reference category)								
R&D intensity (R&D expenditures by sales)								
Innovative intensity (Expenditures on innovation by sales)								+
Personnel in R&D								
Innovative regularity								
Importance of basic research								
Importance of applied research	++	+			+	++		
Importance of technical development			++	++				
Percentage of sales related to "innovative" products								
Percentage of exports related to "innovative" products								+
Saving or reduction of costs		-		-				
Acquiring of experience and knowledge								
Following up of technical advances						-		+
Access to specialities and qualifications not available in their own firm								
Access to infrastructure and equipment not available in their own firm		+++		+		+		
Obligation to obtain public support		+		+				---
Percentage of classified cases No	65	72	71	77	65	68	62	69
Yes	75	80	72	77	72	75	59	65
Total	71	77	72	77	71	73	60	66
X^2 of Nagelkerke	21	32	23	27	20	22	12	18
-2 Log likelihood	410	373	345	333	310	303	469	449
Number of cases No	121	121	88	88	69	69	148	148
Yes	255	255	282	282	307	307	228	228
Total	376	376	370	370	376	376	376	376

Source: Own calculation based on the IAIF/FECYT survey. The symbols indicate the level of statistical significance and the orientation of the relationship. Positive relationships (+++ = 99%: ++ = 95%; + = 90%) or negative relationships (--- = 99%: -- = 95%; - = 90%).

We estimated two types of models. The first one includes only the general characteristics of the firm (size, export behaviour, age, sector and the property structure) and some specific characteristics of their innovative behaviour and results. The second type of models also include the importance of different motives (see table 4.1) to co-operate directly with regard to the supported project.

Looking at the results in table 4.2 we can see that most profiles are very concise. Two main tendencies can be highlighted. First the logistic regression models confirm the relationship between size and each of the basic indicators used to evaluate the impact of the public support schemes. So, large firms depend less on the support schemes, which means that they should be characterised more frequently as freerider. E.g. they would have co-operated or would have carried out the supported project even without the public aid schemes.

The share capital characterised by individual firms, foreign enterprises or firms belonging to a national group or holding is almost not related with the level of impact of the public support. Only in the case of the national firms belonging to a group, independent from their size, we observed a moderately higher level of freeriding from a financial perspective.

Almost no sectoral differences were found and the few statistically significant differences are isolated cases for only one of the four basic indicators. The providers of traditional intermediate goods seem to participate somewhat less frequently in other programmes; the "other manufacturers" have more often a freerider attitude from a co-operative perspective; and the high-tech industries are less frequently freeriders from a financial perspective.

The innovative behaviour is a second characteristic that seems to be an important aspect that influences the level of impact. Although only for few number of variables a relationships was found, the innovative behaviour is related with each of the indicators that reflect the impact of the support measures. The observed relationships indicate -without exceptions- that the most innovative firms show a lower level of impact. The higher the importance of applied research, technical development or the percentage of the export belonging to "innovative" products the lower the impact on the firms co-operative behaviour.

In relation to the motives for co-operation the logistic regression reflects that the firms that co-operate to gain access to infrastructure and equipment -not available in their own enterprise-[13] are more assiduous in participating in different programmes. It also shows with more frequency that they had previous experience in co-operation and more often shows a freerider attitude from a co-operative viewpoint. Probably due to their need to get access to such infrastructure services, those firms would also co-operate without support. From one viewpoint, this fact could diminish the potential impact of the support schemes although from the other viewpoint, the support for co-operation is often justified as facilitating access to public research establishments.

A large number of firms (70% of all supported firms) indicate that they co-operate to fulfil the requirements of the support scheme. These firms more often show prior experience in co-operation and participate more often in several support schemes. This could imply a lower level of impact. However at the same time they less often have a freerider attitude from a financial point of view. E.g. they more frequently raise their R&D expenditures or have more difficulties to finance their projects without the public support scheme.

[13] This motive is considered as important or very important respectively by 29% and 49% of the firms (Taken from Heijs et all, 2004b)

The firms that co-operate to reduce the costs of their innovative activities show a lower level of clientelism and less frequently have prior experience, which means that the impact on their co-operative attitude could be higher than in other firms. However, this motive is not related to the two forms of freeriding (from a co-operative or financial perspective).

Firms that co-operate to follow up the new technological advances are less prone to co-operate without the public support. That is, the support has a positive impact on their co-operative attitude. However this positive effect contrasts with their freerider attitude from a financial perspective i.e. they could probably have financed the project more easily by themselves. To conclude those firms have a lower probability of being freeriders from a co-operative perspective but a higher probability of being a freerider from a financial perspective.

5.- FINAL REMARKS

In this article we revised the empirical findings and methodological problems of the existing survey literature. Based on that revision the author designed a survey (the IAIF/FECYT survey) which evaluates a broad number of aspects related to the level of impact. The paper is focused on two aspects, the increase in co-operation due to public support and the learning effects both for the supported firm and for other agents of the innovation system[14] (e.g. the research institutes involved in the project).

The impact on the co-operative behaviour of the firms seems to be relatively low, a high percentage of firms do have previous experience in co-operation (68%) and most of the firms do or did participate in similar programs (76%). The conclusion about these facts could be that the policies focused on co-operation mostly strengthen or intensify the existing collaborations of the firms already involved in co-operations. While the extension of the co-operative attitude by non-co-operative firms is less successful. A similar conclusion was found by the instrument of financial support of R&D in enterprises. These support measurements enhance the innovative activities of already innovative firms and none of the supported firms initiated innovative activities due to public support (Heijs, 2001/2003). The political agencies should design a instrument that not only strengthens activities of the existing innovation system, but also broadens the number of firms that innovate and collaborate. Moreover the level of freeriding from a co-operative or a financial perspective also is relatively high (81% and 61% respectively). These tendencies confirm the results observed in the existing literature (section 2.3).

In this paper we found apparently a higher level of freeriding than in the existing literature, although this is due to the use of the combined indicators. All other studies (except Heijs, 2000/2001) use only separately variables. Each of them reflects a relatively low level of freeriding although we do not know the interaction of these variables. In fact we recommend the use of such combined variables for future studies.

In spite of the analysis of this paper it can be highlighted that it is not easy to analyse the advantages or benefits in the long term or from the viewpoint of social welfare. It could be imagined, on the one hand, that co-operation improves firms' performance -due to the financial, commercial or technological advantages, in which case they would also co-operate without state

[14] It has to taken into account that the supported projects are initiated and developed by the firms and focused on their particular interest. The firms receive the support and are responsible for the development of the project and its financial aspect.

aid. On the other, if firms only co-operate to fulfil the aid requirements, co-operation has no direct advantage for firms involved and would be more likely to serve to support- or indirectly subsidise through contracts-the public research bodies. In these cases it could be possible that the public research organisation carry out marginal and/or isolated parts of the project in which mutual learning of both partners is not assured. In both cases the increase in social welfare should be generated in an indirect way. The promotion of co-operation could be justified by basing it on the theory of innovations systems. According to this theory-based on a holistic concept- the system creates synergies due to the interaction between its agents who, at the same time, generate a collective learning process. Evaluation studies do not analyse whether a process of collective learning or synergies is generated, but analyse the increase in co-operation and reason that the existence of such an increase would generate, like an invisible hand, a better working of the system as a whole. This way of evaluating the policies is due to the difficulty involved in analysing the increase in social welfare, since it is almost impossible to analyse the net increase in co-operation and the indirect effects on the innovation system.

To analyse the possible impact on the innovation system as a whole we analysed whether the firms and the research institutes involved initiated learning. For seventy percent of the firms and for over seventy percent of the research institutes the learning process, derived from the supported projects, seems to be important or very important and only in 16% of the projects was there no learning at all, neither for the firm nor for the research institute. Earlier studies in Spain (Heijs, 2001/2003) indicate that the firms identified as being "freeriders" less frequently reflect a learning effect of the supported projects and if they exist they are considered as less important. This fact would invalidate the argument of the "evolutionary theory" of accepting freeriding if their are wider social welfare effects. The results of this paper are not totally conclusive, we found a lesser impact for the firms with prior experience in co-operation and those that participate more often in similar public support programs. However both indicators of freeriding (from a co-operative of financial perspective) are unrelated to the level of learning.

A final aspect analysed in the paper is the profile of the firms with a higher or lower level of impact to improve the selection of the innovative projects focused on a reduction of freeriding i.e. improvement of the impact. The two main findings of the logistic regression models confirm the results of the existing empirical studies. On one side it can be pointed out that the size of the firm is a clear explanatory variable related to the freerider behaviour. Large firms are more prone to freeriding, a fact also confirmed by other studies (Becher et al., 1989; Becher et al., 1990; Molero/Buesa, 1995a; Kulicke et al., 1997; IESE, 1995).

On the other hand our results as well as the case studies demonstrate that the high level of R&D efforts and a more innovative orientation correlates with a lower level of freeriding (Meyer-Krahmer, 1987, 1989; Becher et al., 1989, 1990; Molero/Buesa, 1995a; Kulicke et al., 1997; Heijs, 2000/2001; Heijs et all, 2004b). The relatively higher level of freeriding by the innovative firms that reached a very high R&D level -although the differences are small- could perhaps be explained by two reasons. Firstly, innovation is a possible key aspect of their global corporate strategy and an important aspect for their competitive position in the markets where they operate. They are, therefore, forced to carry out their projects anyway. A second explanation could be the fact that those firms have shown well developed technological capabilities and that they built up a situation of mutual trust with the financial institutions.

The results of the IAIF/FECYT questionnaire confirm that the firms belonging to the R&D-intensive sectors are less given to a freerider attitude from a financial perspective (Meyer-

Krahmer, 1989; Becher, 1990). This fact colours the results related to the innovative orientation and efforts. The logistic regression model -which simultaneously analyses the interaction between different explanatory variables- seems to indicate that more innovative firms are more prone to be freeriders, however within this group those that are from the high-tech service sector have a lower level of freeriding. Furthermore, the above average freerider from a financial perspective show by the firms belonging to a group of enterprises (Becher, 1990) is confirmed by our results.

A second important conclusion is that the identification of the firms with a relatively high or low level of freerider attitude shows us that the differences are very small. They seem to be based basically on two indicators: the size and the innovative level of the firm. Moreover some of the motives for co-operation are also correlated with the level of freeriding. This is especially the case of the firms that co-operate to gain access to technical infrastructures not available in their own firm.

The identification of the firms with a relatively high level of freerider attitude was aimed at the improvement of policy implementation. It should offer the public agencies data to establish requirements, criteria or priorities to improve the selection mechanism used for the evaluation of the projects. The analysis, however, offered hardly any results that can be converted into clearly defined requirements, applicable in the practice of project evaluation and that can be defended politically.

The only variable directly convertible into a practical requisite for obtaining credits could be the size of the firm. The results indicate that almost 32% of the smallest firms (up to 100 employees) consider public support as important for their innovative activities, conversely, for the larger firms this percentage does not exceed 10%. Therefore public agencies could require from the large firms a higher interest rate, closer to the market. In this way they do not exclude large firms from the programmes but at the same time freerider attitudes will be avoided.

Other variables related to the different indicators for freerider attitude are not convertible requirements useful in the practice of policymaking, for example, it does not seem reasonable to exclude firms with a high level of R&D expenditures by sales, those that consider the R&D as important or those that co-operate to gain access to the public research infrastructure. These variables though, can serve to revise or improve the internal process of project evaluation.

Annex

Table 4.1.
Existence of prior experience in co-operation

INDICATOR I	% of firms with prior Cupertino experiences by number of employees				S*	% of firms with prior Cupertino experiences by R&D expenditures by sales				S*
	0-100	101-250	251-500	Over 500		0-1	1-3	3-5	Over 5	
With the same institute involved in the subsidised project (1)	46	63	67	77	3	44	65	58	51	2
With other R&D institutes (2)	46	52	60	74	3	40	49	36	51	0
Previous experience in co-operation (1 or 2)	60	79	77	87	3	60	72	71	70	0

Source: Own calculation based on the IAIF/FECYT survey.
* Level of significance: 0 = Not significant; 1 = 90%; 2 = 95%; 3 = 99%.

Table 4.2:
Clientelism (Participation in similar public support programmes that promote co-operation in innovation)

INDICATOR II:	% of firms participating in other programmes by number of employees				S*	% of firms participating in other programmes by R&D expenditures by sales				S*
	0-100	101-250	251-500	Over 500		0-1%	1-3%	3-5%	Over 5%	
Regional programmes (1)	54	64	70	60	0	56	66	56	52	0
National programmes (2)	49	76	88	76	3	54	67	60	63	0
European Union (3)	30	33	48	54	3	38	34	40	30	0
Clientelism or propensity to participate in other public support programmes on co-operation (1, 2 or 3)	68	81	98	90	3	69	81	80	75	0

Source: Own calculation based on the IAIF/FECYT survey.
* Level of significance: 0 = Not significant; 1 = 90%; 2 = 95%; 3 = 99%.

Table 4.3.
Freerider attitude from a co-operative perspective
(Indirect indicator that could reflect thelack of increase in co-operation)

INDICATOR III	% freeriders by number of employees				S*	% of freeriders by R&D expenditures by sales				**S***
	0-100	101-250	251-500	over 500		0-1%	1-3%	3-5%	Over 5%	
Prior co-operation with the same institute involved in the subsidised project **(1)**	46	63	67	77	3	44	65	58	51	2
The Co-operation would also have occurred without public support **(2)**	17	25	23	30	1	20	19	20	23	0
The project would also have been initiated without public support **(3)**	51	53	74	67	2	57	59	49	55	0
Feasibility of the project without public support	42	46	52	54	1	43	49	42	45	0
Freerider attitude from a co-operative perspective (1, or 2 or 3)	**71**	**85**	**91**	**90**	**1**	**77**	**88**	**84**	**77**	**1**

Source: Own calculation based on the IAIF/FECYT survey.
* Level of significance: 0 = Not significant; 1 = 90%; 2 = 95%; 3 = 99%.

Table 4.4:
Freerider attitude from a financial perspective

INDICATOR IV and V	By number of employees				S*	By R&D intensity (R&D expenditures by sales)				S*
	0-100	101-250	251-500	Over 500		0-1%	1-3%	3-5%	Over 5	
The project would also have been initiated without public support (1)	20	37	40	43	3	30	29	22	26	1
The firm has few difficulties to finance the project without support (2)	9	10	11	23	1	15	9	9	11	0
The firm used the support to substitute private by public money (3*)	48	33	42	58	1	50	46	31	57	0
Freerider attitude from a financial perspective (1 or 2 or 3)	**58**	**57**	**70**	**74**	**1**	**65**	**65**	**47**	**60**	**0**
INDICATOR V										
Low technological feasibility of the project without co-operation	**42**	**47**	**48**	**27**	**0**	**44**	**34**	**52**	**43**	**0**

Source: Own calculation based on the IAIF/FECYT survey.
* Level of significance: 0 = Not significant; 1 = 90%; 2 = 95%; 3 = 99%.

Table 4.5 Interaction between the basic indicators

	Prior experience in co-operation		Clientelism	
	Yes	No	Yes	NO
Freerider from a co-operative perspective	58	92	86	67
Freerider from a financial perspective	60[a]	62[a]	66	60

	Prior experience in co-operation or clientelism	
	Yes	No
Freerider from a co-operative perspective	85	58
Freerider from a financial perspective	66[a]	60[a]

	Freerider from a co-operative perspective	
Freerider from a financial perspective	Yes	No
Yes	42,7	6,7
No	23,6	26,9

All differences were statistically significant at a 99% percent level except in the cases marked with an [a] that are not statistically significant

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